REMARKS

1. In response to the Final Office Action mailed October 2, 2002, Applicants respectfully request reconsideration. Claims 1-4, 6-8, 10, 13, 14 and 18-37 were last presented for examination. No claims have been added, canceled or amended in this paper. Thus, claims 1-4, 6-8, 10, 13, 14 and 18-37 remain pending in this application. Of these 30 claims, five claims (claims 1, 18, 27, 28 and 31) are independent. Based upon the following Remarks, Applicants respectfully request that all outstanding objections and rejections be reconsidered, and that they be withdrawn.

Amendments To The Specification

2. Applicants note with appreciation the apparent acceptance of the amendments to the title of this application submitted in the paper filed July 18, 2002.

Claim Rejections Under 35 U.S.C. §103

3. The Examiner has maintained the rejections of the pending claims under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,760,781 to Kaufman *et al.* (hereinafter "Kaufman"). Specifically, the Examiner asserts that:

> As per claim 1, Kaufman teaches the claimed "graphics system comprising:["] "A 2D imaging pipeline" (Kaufman, figure 12). It is noted that [the] Kaufman system receives the 3D objects and store[s] them in 3D buffer 22. However, these 3D data [are] converted to 2D data to store in 2D buffers 73 and 24 suggests "a 2D image pipeline" as claimed. Thus, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to configure Kaufman's system as claimed.
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> (*See,* Final Office Action, para. 2.)

In maintaining the rejection, the Examiner copied the above text verbatim from the first office action. (*See*, Office Action dated 4/12/02, para. 2.) In this final office action, the Examiner, noting that Applicants' arguments were deemed unpersuasive, added solely the following sentence in reply to Applicants' prior arguments:

> It is clear that Kaufman's voxel information stored in the 2D buffer is indeed a representation of [a] "2D image" and the manipulation of this 2D image[] generates "a 3D image" as claimed.
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> (*See,* Final Office Action, para. 2.)

In sum, the Examiner's position is that because Kaufman's volume rendering pipeline converts 3D voxel data to 2D voxel data, Kaufman's teaches a 2D imaging pipeline, and that Kaufman suggests using a 2D imaging pipeline to composite separately-generated 3D images (as claimed) because Kaufman's volume rendering pipeline manipulates 2D voxel data to generate a 3D image. Applicants traverse this rejection.

4. Applicants respectfully assert that, contrary to the Examiner's assertions, Kaufman neither discloses, teaches nor suggests a *two-dimensional graphics imaging* pipeline as recited in claim 1. The Examiner's apparent position that any pipeline having 2D arrays is a 2D imaging pipeline is in conflict with definition of the term used in Applicants' specification. It is well settled that the terms of a claim are to be construed as defined in the specification. Where "words [are] defined in the specification [, they] should be given the same meaning in the claims." *Amazon.com Inc. v. Barnesandnoble.com Inc.*, 239 F.3d 1343 (Fed. Cir. 2001). Thus, "the PTO [is to] appl[y] to verbiage of the proposed claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill in the art, taking into account whatever enlightenment by way of definitions or otherwise that may be afforded by the written description contained in applicant's specification." *In re Morris*, 127 F.3d 1048, 1054-55 (Fed. Cir. 1997). "During patent examination, the pending claims must be given the broadest reasonable interpretation consistent with the specification. (*See*, MPEP §2111; emphasis added.)

5. Applicants' specification defines a "two-dimensional graphics imaging pipeline" as a graphics pipeline that processes pixel data having x and y coordinates and no z (depth) coordinate. This interpretation was discussed at length in the Response & Amendment filed July 18, 2002 ("Amendment A"). In Amendment A Applicants also provided excerpts of "Introduction to Volume Rendering" by Barthold Lichtenbelt, Randy Crane and Shaz Naqvi, Prentice Hall PTR, 1998 ("Lichtenbelt") describing different types of graphics pipelines. (*See*, Amendment A, paras. 6, 7, 10; Attachment 1.) That discussion was seemingly ignored by the Examiner since the Examiner has not specifically addressed Applicants' arguments, has not provided additional art, nor taken Official Notice of the Examiner's unsupported contentions.

6. To briefly reiterate, then, there are three types of graphics rendering pipelines: a volume rendering pipeline, a 2D imaging pipeline, and a primitive rendering pipeline.

Each rendering pipeline has specific structure to perform specific operations on specific types of data: a 2D imaging or pixel pipeline processes 2D pixel data; a 3D or geometric pipeline processes primitive data; and a volume or voxel rendering pipeline processes voxel data. There is no capability provided in one rendering pipeline to perform the processing of the other pipelines because, as mentioned, appropriate hardware and software are required to process particular data types.

7. The above definition of a 2D imaging pipeline and a geometric pipeline are set out in Applicants' specification:

> There are two paths through a rendering pipeline, one for primitive data and one for pixel data. The former path processes three-dimensional (3D) primitive data to form a two-dimensional (2D) image for display on a 2D display screen. The latter path manipulates pixels, images and bitmaps of existing 2D images. The Cartesian coordinates of an image include X and Y coordinates corresponding to the pixel address in the horizontal and vertical dimensions of the display screen, and the Z coordinate which is orthogonal to the display screen and represents the distance from the location of the viewer, referred to as the viewpoint. The former path is referred to herein as a 3D pipeline due to the inclusion of depth information (Z coordinate data) in the primitive data. In contrast, the latter path is referred to as a 2D pipeline due to the absence of Z coordinate data from the 2D image data. This is because only the address (X,Y coordinate) and color (R,G,B,A) data is required to display a 2D image on a 2D display screen.
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> (*See*, Applicants' application, pg. 3, ln. 26-pg. 4, ln. 8.)

A proper interpretation of Applicants' independent claim 1, therefore, requires that the term "2D graphics imaging pipeline" be construed as a graphics pipeline that processes pixel data having x and y and no z (depth) coordinate data.

8. Kaufman discloses not a 2D graphics imaging pipeline but a volume rendering pipeline. As discussed in Amendment A with reference to Lichtenbelt, volume rendering is a method for processing an input volume data set to show the characteristics of the interior of a solid object when displayed on a 2D computer monitor. The volume data set is a three-dimensional array of voxels, which are 3D volume elements representing discrete samples within a three-dimensional space. (*See*, Amendment A, paras. 7-9;

Lichtenbelt, pgs. 28-30 and 173-176.) Kaufman's volume rendering pipeline, in contrast to the then-conventional systems, incorporates multiple 2D buffers in the manner disclosed in Figures 3 and 12 to increase the speed and efficiency of the volume rendering process. Specifically, Kaufman's device uses a cubic frame buffer 22 operationally connected to three 2D buffers 24. The cubic frame buffer 22 first stores the input volume data set of voxels. Thereafter, the volume data set is divided into 2D portions, or so-called slices, each slice being stored in the 2D buffers 24 for subsequent interpolation. Thus, Kaufman's 2D buffers store 2D voxel arrays of the volume data set for fast, bi-linear interpolation. (*See*, Kaufman, col. 6, lns. 20-63.)

9. Kaufman discloses only the above volume rendering pipeline. Kaufman neither discloses, teaches nor suggests Applicants' 2D graphics imaging pipeline, namely a graphics pipeline that renders 2D images formed from 2D pixel data having x and y coordinates and no z (depth) coordinate. Contrary to the Examiner's assertion, the mere use of 2D buffers in a volume rendering pipeline does make such a volume rendering pipeline a 2D imaging pipeline. Kaufman's volume rendering pipeline (with bi-linear interpolation of 2D slices of voxels) is unrelated to a 2D graphics imaging pipeline that processes pixels. Voxels are not pixels whether arranged and processed in a 3D array or a 2D array. Thus, the Examiner's statement that Kaufman's voxel information stored in the 2D buffer is a representation of a 2D image is erroneous; it is a representation of a plane of voxels; that is a plane of 3D volume elements each representing a discrete sample within a three-dimensional space.

10. Moreover, Applicants assert that there is no suggestion in the art of record to modify Kaufman to implement a two-dimensional graphics imaging pipeline that manipulates 2D images and composites separately-generated 3D images. Rather, the art of record is silent with regard to performing such operations or achieving such an objective. The Examiner's statement that Kaufman's manipulation of 2D images generates a 3D image appears to be directed to this claimed feature. Not only is this statement inaccurate, it is irrelevant. Kaufman receives a 3D array of voxels and converts them to 2D arrays of voxels for fast interpolation that ultimately generates a 2D image, not a 3D image as alleged by the Examiner. And even if Kaufman were to teach generating a 3D image, which it does not, there remains no teaching or suggestion to composite 3D images in a 2D imaging pipeline as recited in Applicants' claim 1.

11. The Examiner has, therefore, failed to provide any *evidence*, whether in the form of some teaching, suggestion, incentive or inference in Kaufman or other art of record, or in the form of generally available knowledge, that one having ordinary skill in the art *would have been led* to modify the relevant teachings of Kaufman in the proposed manner. This is because no such motivation exists in the applied references. The only conclusion that can be drawn, based on the record of this application, is that the suggestion forming the basis for the Examiner's conclusion must have come from Applicants' own novel disclosure; that is, the Examiner appears to be engaging in impermissible hindsight. Applicant's own novel disclosure cannot be used to supply the teaching or suggestion that is missing from the known art. Furthermore, for the reasons set out above, Applicants assert that even if one of ordinary skill at the time of the invention were motivated to modify Kaufman as proposed by the Examiner, the resulting system would not contain nor would it have the advantages of Applicants' invention as recited in the independent claims. For at least these reasons, Applicants respectfully request that the rejection of independent claim 1 be withdrawn.

12. Moreover, the Examiner has failed to provide any substantive treatment of the other independent claims 18, 27, 28 and 31. These other claims recite methods and apparatus that provide additional detail to the subject matter recited in independent claim 1. Accordingly, claims 18, 27, 28 and 31 are patentable for at least the same reasons as those above. For at least these reasons, Applicants respectfully request that the Section 103 rejection of independent claims 18, 27, 28 and 31 be reconsidered and withdrawn.

13. Because the dependent claims 2-4, 6-8, 10, 12-14, 19-26 and 29-30 depend directly or indirectly from the respective independent claims and incorporate all of the subject matter thereof, they too are not rendered obvious by Kaufman or any other art of record. Furthermore, these dependent claims add additional subject matter which makes them independently patentable in and of themselves over the art of record. Accordingly, Applicants request reconsideration and withdrawal of the rejection to all dependent claims.

CONCLUSION

14. In view of the foregoing Remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested.

Respectfully submitted
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